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Predation of wildlife by free-ranging domestic dogs in Polish hunting grounds and potential competition with the grey wolf

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ABSTRACT

Although the domestic dog (*Canis familiaris*) is a ubiquitous exotic predator that can detrimentally affect natural environments, studies on their ecological impact are relatively scarce, particularly at a national scale. We exploited data derived from Polish Hunting Association reports to provide a national evaluation of rural free-ranging dogs in Poland. Our results demonstrate that free-ranging dogs are widespread and abundant, frequently killing wildlife and livestock in Poland and likely exerting intraguild competition with native carnivores such as grey wolves (*Canis lupus*). On average, hunting club records estimate that over 138,000 rural free-ranging dogs occurred annually in hunting grounds. In addition, nearly 3000 free-ranging greyhounds and their mixed breeds occurred annually on hunting grounds, although greyhound hunting has been banned in Poland and they are legally required to be restrained within fencing. On average, over 33,000 wild animals and 280 livestock were killed by free-ranging dogs on Polish hunting grounds annually. The number of both wild animals and livestock killed by dogs were strongly and positively correlated with the numbers of rural free-ranging dogs recorded on hunting grounds, reflective of their predation pressure. Also, the number of wild animals killed by dogs was positively correlated with estimates of population sizes and harvest levels of wildlife, reflective of prey availability. Dog predation, in conjunction with harvest by humans, may cause unsustainable off-take rates of some game species. Grey wolves, documented within 39 of the 49 Hunting Districts, ate similar prey as dogs, including ungulates and livestock, and killed dogs on hunting grounds, suggesting both resource and interference competition between these sympatric canids. This comprehensive analysis provides important information about the ecological impact of free-ranging dogs and recommendations for alternative legislative and management measures to control their impacts.

1. Introduction

Domestic dogs (*Canis familiaris*) are among the most popular companion animals and one of the world's most common carnivores (Gompper, 2014b). Globally, dog ownership is widespread, ranging from 37% of US households (AVMA, 2012), 27% of European households (FEDIAF, 2010), 39% of Australian households (AHA, 2014), and up to 86% of households in Chile (Sepulveda et al., 2014; Silva-Rodríguez and Sieving, 2012). The worldwide dog population is estimated to be between 700 and 900 million (Gompper, 2014b; Hughes and Macdonald, 2013). Given their close association with and subsidies from humans, dogs have access to most ecosystems globally (Gompper, 2014b; Hughes and Macdonald, 2013, Young et al., 2011).

A growing body of literature demonstrates that dogs can have significant detrimental effects on natural environments. For example, dogs act as predators of a variety of native fauna, primarily mammals but also birds, reptiles, amphibians, and invertebrates, and also prey on domestic livestock (Hughes and Macdonald, 2013; Ritchie et al., 2014; Vanak and Gompper, 2009; Young et al., 2011). Non-lethal interactions can also disturb wild animals, including disruption of physiology and normal behaviour such as foraging, vigilance, and bedding (Weston and Stankowich, 2014). Dogs carry pathogens transmissible to wildlife and humans, serving as reservoirs and vectors for disease such as rabies and canine distemper virus (Knobel et al., 2014; Macpherson et al., 2013). Intraguild interactions between domestic dogs and native carnivores can be particularly impactful. Dogs act as resource and interference competitors with sympatric carnivores, competing for prey and

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carrion and excluding, and sometimes killing, predators in their guild (Butler and du Toit, 2002; Vanak et al., 2014; Vanak and Gompper, 2009). Conversely, dogs also serve as prey for other carnivores, exacerbating human-carnivore conflict (Butler et al., 2014; Kojola and Kuittinen, 2002; Young et al., 2011). Additionally, dogs hybridize with native canids, including wolves (*Canis lupus*. *Canis simensis*), jackals (e.g., *Canis aureus*), and coyotes (*Canis latrans*), resulting in loss of genetic integrity (Leonard et al., 2014).

Recent publications (e.g., Hughes and Macdonald, 2013; Lescureux and Linnell, 2014; Ritchie et al., 2014) stress the paucity of scientific studies on the ecological impact of domestic dogs. Research on the impacts of domestic dogs at a national rather than local scale are notably scarce. Legislation in Poland specific to dogs and wildlife provides an unusual opportunity to conduct such an analysis. The 1995 Hunting Act in Poland stipulates that hunting can be exercised only by members of the Polish Hunting Association (PHA), with Poland divided into hunting grounds managed by hunting clubs within 49 Hunting Districts. Recent data estimate 116,000 hunters in the 2550 PHA hunting clubs (CSO, 2014). Although members of hunting clubs can hunt free of charge, they are obliged to deliver the harvested animals to hunting club headquarters as all game belong to the Polish government. Hunting Districts must prepare annual hunting reports that include data on hunting ground management, annual harvest, and estimated population sizes of game species. In addition, reports include information on free-ranging dogs, both owned and stray, including greyhounds, which are still illegally used for hunting.

Poland contains an estimated 6–8 million dogs (Fiszdon and Boruta, 2012; Tasker, 2007), including between 75,000 and 650,000 strays (Kołłątaj et al., 2011; Tasker, 2007). No study has evaluated the population status, management, and ecological impact of free-ranging dogs in Poland. Here, we exploit data derived from Polish Hunting Association reports to provide the first national evaluation of rural free-ranging (RFR) dogs, including their numbers and their prey recorded by hunting clubs between 2001 and 2011. We hypothesized that dog abundance would positively predict depredation of wildlife and livestock on hunting grounds. We also hypothesized that depredation events would be positively correlated with prey availability, as indexed both by estimated population sizes of wildlife as well as hunter harvest. In addition, we evaluated available data on the geographic distribution of free-ranging grey wolves in Poland between 2006 and 2011 to predict the degree of spatial overlap and hence potential intraguild interactions by dogs and wolves. This comprehensive analysis represents one of the first such studies of dogs and their impacts on a national scale and provides important guidance on alternative legislative and management measures to control their impacts.

2. Materials and methods

2.1. Study area

The study was conducted in Poland, a 322,575 km^2 country with an estimated 38.5 million people, including 23.3 million urban and 15.3 rural residents (CSO, 2014). Poland contains 4696 hunting grounds encompassing 252,546 km^2. Each hunting ground is rented and managed by a hunting club for at least 10 years. Each hunting club contains at minimum 10 hunters. According to the Polish Hunting Act, each hunting club must employ at least one hunting guard who lives in close proximity to the hunting grounds and is responsible for continuously monitoring the area. There are approximately 7200 hunting guards distributed across the 4696 hunting clubs.

Until 1997, free-ranging domestic cats and dogs observed by hunters in hunting grounds were considered pests and had to be eliminated by shooting. Between 1981 and 1996, the average (SD) annual numbers of domestic dogs and domestic cats killed was 59,596 (10,069.5) and 58,427 (10,158.3), respectively (RS PHA, 1998). A 1997 Polish Animal Protection Act, however, mandated that dogs and cats could be killed only in specific instances, such as humanitarian or health circumstances or excessive aggressiveness towards humans. The potential ecological impact of domestic dogs and cats was disregarded in Polish law until 2003, when a new regulation was amended to the Animal Protection Act permitting shooting of free-ranging cats and dogs at least 200 m from the nearest households within hunting grounds. Increasing public protest forced additional revisions to the Act in 2011 and 2013, which still allowed lethal control when animals presented a direct threat to humans or wildlife, but stipulated other management options for free-ranging dogs, including requiring restraint of owned dogs and trapping roaming dogs and placing them in animal shelters.

A separate regulation relates to greyhounds, which have a long traditional link to hunting in Poland. The Polish greyhound, originating in the 13th century, is officially registered as a dog breed by Federation Cynologique International (Davis, 1999). Until the mid-20th century, these dogs were bred and used for chasing game. In 1959, hunting with greyhounds was banned in Poland and breeding of greyhounds was allowed only with permission of local municipalities. Although greyhounds and their mixed breeds must be kept in fenced enclosures to prevent escape, they are still found in Polish villages and are used for illegal hunting, especially on brown hares (*Lepus europaeus*).

2.2. Data collection

We collected data from hunting reports submitted by the 49 Polish Hunting Districts between 2001 and 2011. We summarized data on estimates of the numbers of free-ranging dogs observed by hunters on hunting grounds. As illegal hunting with greyhounds is still a problem in some regions of Poland, hunting clubs are obliged to report such cases in their annual reports; villages are inspected by designated hunters and local municipality officers to verify if the owner has written permission to own a greyhound and if housing conditions are in accordance with the regulation mandating greyhound enclosures.

We classified dogs as RFR, which, following Vanak and Gompper (2009), are owned or peripherally associated with human habitations but not confined to prescribed outdoor areas. Such dogs include 'stray' dogs as well as owned farm or pastoral companion dogs whose ranging behaviour may bring them into contact with wildlife, especially when human habitations border natural habitat. Because hunting club members, including designated hunting guards, are often local villagers that live in the vicinity of hunting grounds, they communicate regularly with dog owners and typically know owned dogs and can recognize and identify unowned strays. The phenotypic diversity of dogs, including differences in size and pelt colour, enables hunting guards and club members to identify individual dogs and avoid double-counting. Nonetheless, the possibility remains that some double-counting does occur, resulting in an overestimation of the dog population. The procedure for counting dogs in hunting grounds is the same in all hunting clubs across Poland and is controlled and evaluated by the Polish Hunting Association, so any possible estimation bias is similar across Hunting Districts.

We also collected reported data on annual estimates of populations of game species on hunting grounds, estimated directly via visual observations of animals during line-transect distance sampling, drive counts, or plot sampling, or indirectly via track counts (Borkowski et al., 2011; Chećko, 2011; Fonseca et al., 2007). Although survey methods differ among clubs and thus have limitations (Wawrzyniak et al., 2010), we assumed that they were reliable enough to provide comparable information on the relative abundance of game species, as have prior studies (e.g., Borkowski et al., 2011; Panek, 2006). In addition, we summarized data on harvest levels within each hunting ground. Because harvest management plans are based upon the estimated population of a game species, we assumed that harvest levels also reflected relative abundance of game and thus prey availability. Hunters cannot harvest more game than is permitted by the harvest management plan and cannot attribute their own harvest to dogs or wild predators. We focused